

APPLICATION

FOR

UNITED STATES LETTERS PATENT

**TITLE: FABRICATING DEEPER AND SHALLOWER
 TRENCHES IN SEMICONDUCTOR STRUCTURES**

INVENTORS: Ilya Karpov and Tony Ozzello

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FABRICATING DEEPER AND SHALLOWER
TRENCHES IN SEMICONDUCTOR STRUCTURES

Background

This invention relates generally to forming trenches such as trenches for isolation purposes, in the fabrication of microelectronic integrated circuits.

5 In some cases, it is desirable to form trench isolations with two different trench depths. Conventionally this may be done by forming a trench of a first depth, covering the formed trench, and forming a trench of a second depth. Trenches of different depth that
10 run parallel to one another may be formed by etching the shallow trench and then the deep trench. More particularly, both the shallow and the deep trench may be formed to the shallow depth. Then one shallow trench may be protected, for example with resist, leaving one of the
15 shallow trenches unprotected. The unprotected shallow trench is then extended with etching to form the deeper trench.

 However, this approach does not work when the trenches cross one another. For example, if two shallow trenches
20 are etched across one another and then one of the trenches is protected with a resist while the other trench is deepened, the deeper trench has a bump where it crosses the

shallow trench because of the protection applied in the shallow trench.

Thus, there is a need for better ways to fabricate trenches at different depths that cross one another.

5 Brief Description of the Drawings

Figure 1 is an enlarged top plan view of one embodiment of the present invention;

Figure 2 is an enlarged cross-sectional view at an early stage of manufacture of the structure shown in Figure
10 1 in accordance with one embodiment of the present invention;

Figure 3 is a cross-sectional view corresponding to Figure 2 at a later stage of manufacture;

Figure 4 is a top plan view at a subsequent stage of
15 manufacture in accordance with one embodiment of the present invention;

Figure 5 is a cross-sectional view taken generally along the line 5-5 in Figure 4; and

Figure 6 is a cross-sectional view taken generally
20 along the line 6-6 in Figure 1.

Detailed Description

Referring to Figure 1, a deeper trench 12 may cross a shallower trench 16. Each of the trenches may be formed in the same wafer 10. The trench 12 may be filled with a fill

material 14 and the trench 16 may be filled with a fill material 18.

Initially, the deeper trench 12 may be formed and may be filled with an appropriate protective layer including a portion 20 on the surface of the wafer 10 and a portion 22 that collects down in the trench 12 as shown in Figure 2. Because of the topography of the trench 12, more of the fill material 22 may collect within the trench 12 than on the surface of the wafer 10. Thus, the thickness of protective material 22 may be greater than the thickness of the protective material 20. The protective material 20, 22 may be resist, spin-on glass, or spin-on polymer, to mention a few examples.

Thereafter, the material 20 may be removed from the surface of the wafer 10 using an appropriate etching process. However, because of the greater thickness of the material 22 within the trench 12, a substantial portion of that material remains as indicated in Figure 3. This remaining material 22 is effective to protect the trench 12 during the etching of the shallower trench 16.

Referring to Figure 4, the shallower trench 16 may be etched with the material 22 still in the trench 12. As shown in Figure 5, the shallower trench 16 may be etched with the upstanding material 22 remaining in the deep trench. Thereafter, the fill material 22 may be cleaned as shown in Figure 6.

As a result, the deeper trench 12 may be formed first and the shallower trench 16 may be formed second without the problem of creating an irregularity where the trenches cross.

5 While the present invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall
10 within the true spirit and scope of this present invention.

What is claimed is: